PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Transportation Fuels and Chemicals

11/2001

A NOVEL VAPOR-PHASE PROCESS FOR DEEP DESULFURIZATION OF NAPHTHA

LEAD INDUSTRY PARTNER

Research Triangle Institute
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PARTICIPANTS

Kellogg Brown & Root
16200 Park Row
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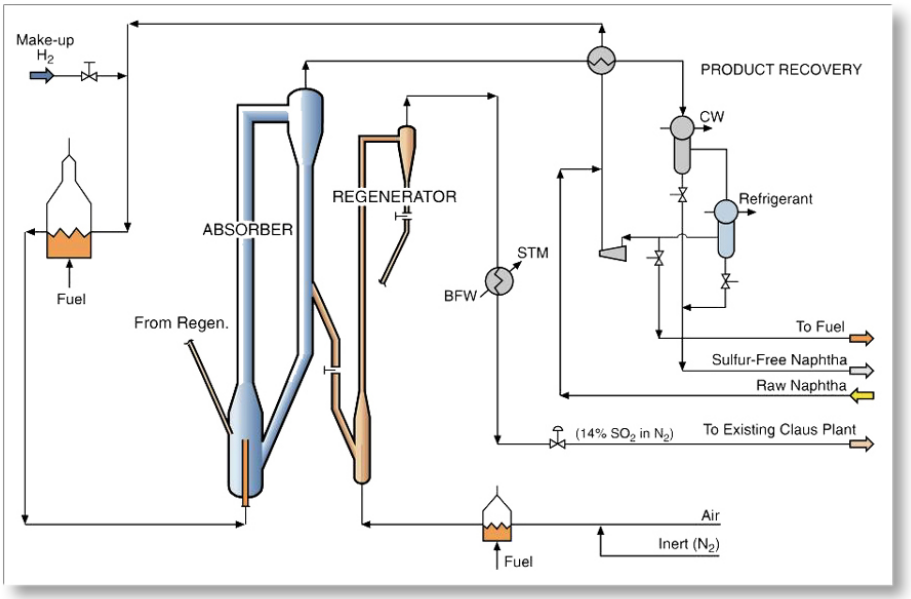
COST SHARING

DOE	$1.3 million
Non DOE	$0.7 million

Description

This project addresses the challenges of producing ultra-clean, fossil fuel-based transportation fuels (low-sulfur gasoline and low sulfur diesel), primarily using existing refinery infrastructure. Most of the sulfur content of gasoline is derived from only one of the blend streams- naphtha from the fluid-bed catalytic cracker ("FCC naphtha"). For diesel, the challenge of removing sulfur is more complex because many of the blend streams used to make diesel have high sulfur concentrations and the sulfur compounds in these streams are significantly more difficult to treat with conventional methods. RTI is focusing its efforts on developing a cost-effective, efficient process to desulfurize the high sulfur blend streams for both gasoline and diesel, thus enabling optimal performance of vehicle emission control systems. Kellogg, Brown & Root, Inc (KBR) will provide pilot plant testing of the process and engineering design.



Proposed commercial embodiment of the RTI Transport Reactor Naphtha Desulfurization (TReND) process. The heart of the process is a pair of high throughput transport reactors. In the first, naphtha vapor contacts solid sorbent particles for capturing the sulfur compounds. In the second, an air stream regenerates the sorbent and discharges the sulfur as a separate SO_2 stream.

A Novel Vapor-Phase Process for Deep Desulfurization of Naphtha

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There are existing technologies for desulfurization that refiners can use to reach the regulatory limit for gasoline and diesel, but there are a number of problems. High capital and operating costs, octane loss, and yield loss resulting from production of low-value products plague many of the popular desulfurization technologies and could result in unacceptable increases in the price of gasoline (as much as 5 to 8 cents/gallon according to some estimate). Removal of sulfur from diesel to these ultra low levels (<15 ppmw) by conventional hydrotreating process is extremely capital intensive and requires large quantities of high-purity hydrogen at elevated pressures (>700 psi). RTI is developing a new desulfurization process, based on a different process chemistry, to remove the sulfur from naphtha and diesel at substantially lower capital and operating cost.

The RTI Transport Reactor Naphtha Desulfurization (TReND) Process, selectivity reacts the organic sulfur compounds with a solid catalyst material to remove them from the naphtha diesel. The sulfur is removed from the process, concentrated, and prepared for ultimate disposal by reacting the sulfur-loaded catalyst material with air. By using high-throughput transport reactors instead of fixed- or fluidized-bed reactors, reactor vessel size is minimized and capital cost is significantly reduced. Side reactions that result in yield loss are minimized. Based on the development to date, the research team believes this deep desulfurization technology can produce ultra-clean transportation fuels with sulfur content much below the Tier 2, 30 ppmw standard for gasoline and 15 ppmw standard for diesel.

Process Development Unit at RTI

This desulfurization technology represents a spin-off application of the sorbent-based desulfurization technology developed by DOE's National Energy Technology Laboratory under the Clean Coal Technology Program. This research effort focuses on adapting and optimizing this technology for transportation fuel desulfurization, conducting sufficient pilot plant testing, and performing a detailed technical and economic evaluation based on the pilot-plant results to convince refineries of its merits and value. Commercial deployment of this technology will enable vehicle manufacturers to obtain optimum performance of their emission control systems.